School Construction Technology Checklist

Office of Education Technology (OET)
Technical Guide

School Construction Technology Checklist

This document is intended as a foundation to be used by local school district Chief Information Officers (CIOs), other district staff involved in facilities (building and district level administrators) and KETS Partners to guide discussions related to new construction as well as renovation of existing facilities. While you will find many of the areas of technology related to the Kentucky Education Technology System (KETS) within the following pages, this document is dynamic and will continue to be updated as facility needs warrant and new standards are released.

Within each section you will find a general document, typically one to two pages, that gives a brief overview of that particular piece of technology. For example, the "Fixed Interactive Whiteboard Systems" section gives a brief overview of the types of whiteboard systems, specifications that should be considered and links to any related standards documents that should be considered and incorporated into any decision making process. In this example , as Intelligent Classroom implementations continue to evolve requirements within the Technology Checklist document will be updated to reflect similar changes.

Where applicable, references to available KETS or other contract sources have been made. In regards to technology where current KETS contracts already exist, it is required under statutory mandate that the technology being purchased come from the appropriate KETS contract.

Funding Sources

Districts should look to various funding sources as appropriate to support technology implementations within their district. For each type of technology listed within this document you will find a listing of applicable funding sources which includes: KETS (S/L), Local (L) and Facilities (F). Each type of funding source should only be used where appropriate and available.

Your KETS Customer Relationship Manager (CRM / KETS Engineer) can assist with questions concerning the appropriate use KETS and Local funds. The guidelines for use of Facilities (Construction) funds are that the technology item must be fixed equipment and part of the building. For questions and final approval on use of Facilities (Construction) funds you should contact Mark Ryles in District Support Services at the Kentucky Department of Education.

Intelligent Classroom

Students and teachers in Kentucky would like access to many technology tools available for today's classrooms. These tools include two-way video desktop conferencing, electronic projection and whiteboards, interactive student voting for formative testing, wireless, phone conversations over Internet, Instant Messaging (IM), speech recognition, large-scale e-books, electronic paper and grid computing. Using these technology tools while being managed by technology-knowledgeable teachers, students can develop the ability to take charge of their own learning and can perform work at their own paces through differentiated learning. Ultimately, technology can allow children to develop at their own paces, learn in a way that is most beneficial for each student and meet the goals of the state's curriculum requirements.

This type of advanced learning necessitates teachers who bring a fresh perspective to instruction and are supported in their use of educational technology. Schools and classrooms, both real and virtual, must have teachers who are equipped with technology skills, have direction from a number of professional development resources and who are, as a result, motivated and excited by educational technology. By utilizing the previously mentioned tools, teachers can effectively teach the necessary subject matter content while incorporating technology concepts and skills.   Educational technology should provide students with real world experience by exposing them to independent source material, critical problem-solving analysis and unprecedented collaborative tools.

Kentucky understands the importance of providing every student with a classroom environment that emphasizes modern technology in every classroom, a connection to the information superhighway and diverse online resources. By making this vision a reality, students will achieve proficiency and be prepared to continue on to and succeed at higher education, business, the military or any other endeavor they choose to pursue.

It is the goal within the state of Kentucky to provide a supportive instructional environment where students utilize the latest and most advanced learning methods. In order to achieve this supportive instructional environment, schools must integrate technology across the curriculum to transform traditional classrooms into dynamic learning environments.

Using these technology tools, and being managed within the classroom by technology-knowledgeable teachers, students can develop the ability to take charge of their own learning and can perform work at their own pace through differentiated learning. Ultimately, technology can allow children to develop at their own pace, learn in a way that is most beneficial for each student, and meet the goals of the state's curriculum requirements.

Product Standards

Our approach is an enterprise design in which all districts are working toward common objectives. When all districts use product standards, all of the state's school districts maximize the taxpayer dollars by ensuring the highest possible levels of interoperability and a consistent look on any workstation across the state. Standards also minimize the retraining required when staff move between schools or districts and lessen the annual support required after implementation. The purchasing power of the state is maximized by leveraging the weight of the entire organization to buy a product standard.   The Gartner Group noted that Kentucky was saving millions with the architectural standards approach.

Components for Which Standards already exist or are being established:

- Student, teacher and administrator workstations

- Instructional and administrative printers

- Instructional and administrative fileservers

- Network components: routers, network concentrators, network interface units, network interface cards, network computing services, CSU/DSUs, network switches, Telco data lines, Telco voice lines

- Building wiring (incorporates EIA/TIA standards): work area wiring, horizontal wiring subsystem, building backbone subsystem, campus backbone subsystem, power wiring, installation standards

- Remote communications: VPN

- Software: network operating systems, operating systems, relational database systems, office products (word processing, spreadsheet, calendar, graphics, end-user database), electronic mail, Internet browser, remote access software, proxy software, network management software, desktop management software

- Instructional software: KETS does not establish specific standards for instructional software. KETS has developed guidelines in the form of a checklist for educators to use during software selection. Instructional software must run, however, on KETS-standard hardware in a KETS-standard network environment. To secure discounted pricing, KETS does issue competitive solicitations and establish price contracts for the most popular instructional software products.

- Applications: District financial management and Administrative management, School student management, District-level accumulator, online instructional software review service

- Television monitors

- Help Desk services

- Maintenance services

- Multimedia applications and services: projectors, whiteboards

- distance learning: Kentucky Virtual High School (KVHS), Kentucky Telelinking Network (KTLN), Kentucky Virtual Library (KVL), Kentucky Education Television (KET), Kentucky Virtual University (KVU)

- proficiency training

- assistive and adaptive technology

- enterprise database

- instructional and administrative technology integration leadership

- STLP

- telephone systems

Technology Standards

Technology Standards represent a uniform set of specifications and guidelines which are leveraged to insure system interoperability and reduce operational complexity, therefore reducing the overall Total Cost of Ownership.

"The Commonwealth is committed to the guiding principle of viewing technology investments from an enterprise perspective. The Enterprise Architecture and subsequent standards represent the overall plan and a living process for designing and implementing information technology solutions to serve both instructional and business functions.

An information technology architecture and related set of standards are vital to ensure the compatibility of the current IT projects and other future IT initiatives. The Enterprise Standards are important for defining the rules by which technology is envisioned, implemented, and managed."

Since 1992, Enterprise Standards have anchored all instructional, administrative, and technical aspects of Education Technology. These standards have afforded the Commonwealth a) significant savings in the initial procurement of technology equipment, b) equitable supportability regardless of geographic location, c) a foundational infrastructure to provide for secure, global ease of access, d) statewide collaboration via various forms of electronic mediums (email, telephonic, video-conferencing), e) statewide adoption of the Internet as an instructional resource, and f) uniform business applications to address both student management and financial management. All Commonwealth of Kentucky Public School districts share in the benefit of each of these efficiencies due to a common set of technology standards.

Standards Community

A standards organization, also referred to as standards development organization or SDO, is any entity whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise maintaining standards that address the interests of a wide base of users outside the standards development organization.

KETS Standards are derived and/or subsequently adopted with either input from, or as a directive of a variety of these entities:

- **Industry Standards Organizations** such as ANSI, IEEE, IETF, SANS, ISC2.

- **Legislative Organizations** such as the Kentucky General Assembly, and the Kentucky Board of Education.

- **Educational Organizations** such as ISTE, SREB, CCSO, and NECC.

- **State Organizations** such as the Commonwealth Office of Technology (COT), and Kentucky Department of Education (KDE).

- **Research Organizations** such as Gartner.

- **Product Development Organizations** such as Microsoft, Dell, Nortel, and various vendor consortiums such as SIF.

Enterprise Architecture, Policy, Products, and Standards

Enterprise Architecture and Standards covers the broad spectrum of technology environments to include software, hardware, networks, applications, data, security, access, communications, project management and other relevant architecture disciplines. These technology areas are described in domains, and each domain contains enterprise policies, standards, and products to support the vision. Additionally, specific technology components (hardware or software) which have been deemed by either the Kentucky Department of Education or Commonwealth Office of Technology as an enterprise component and subsequently made available via a Statewide Procurement vehicle (State or KETS Contract) are considered KETS and/or State Product Standards.

These product standards are listed within the respective Enterprise Standards Domains:

Enterprise Standard Domains

- **Infrastructure**
  - **Network**

    LAN, WAN, Wireless, Protocols, Components, Computing Services, Switches/Hubs, Modems, Installation Standards

  Security Systems

    Information Security Management, Architecture and Models, Access Control Systems and Methodology, Applications and Systems Development, Operations Security, Cryptography, Physical Security, Telecommunications, network and Internet Security, Business Continuity Planning, Law, Investigation and Ethics

  Hardware

    Desktop Computers (PC, MAC), Servers, Printers, Tablets, Fileservers

  Software

    Operating Systems, Office Suite, Database Management Systems, Email, Proxy, Internet Browser, Remote Access, Anti Virus, Multimedia

- **Data** - common data elements, data definitions, naming conventions, geographic information system (GIS) data standards

  Administration

  Management

  Metadata

- **Operations Environment**

1. **Support Management**

   A)   Helpdesk

2. **Operations Management**

   A)   Performance Monitoring, Backup, etc.

3. **Web Management**

4. **Systems Management**

   A)   Tools for management and control of servers, networks and IT infrastructure

- **Communications**

   5. **Internet**

   6. **Telephony**

   A)   Email, Voicemail, Interactive Voice Response (IVR)

- **Project Management -** Discipline of defining and achieving targets while allocating use of resources (time, money, people, materials, energy, space, etc.) over the course of a project.

   7. **Tools and Method**

All KETS and State Enterprise Architecture, Policies, Products, and Standards can be located at the following URLs:

KETS Standards - http://www.education.ky.gov/KDE/Administrative+Resources/Technology/Technology+Architectural+Policies+and+Standards/default.htm

State Standards - http://cot.ky.gov/policies/

Architectural Standards Committee

The KETS Architectural Standards Committee (KASC) has been formed to participate in the overall governance aspects of Architectural Standards adoption and/or modification. This committee is comprised of both local school district and KDE representatives, and is charted to provide guidance, input, and recommendations into the overall process of standards adoption.

The KASC meets on a monthly basis and submits its recommendations to the Office of Education Technology. Once the request is accepted members at times where appropriate may work very closely on various action teams to provide the content for the recommended standards that will be generated.

For more information visit:
http://www.education.ky.gov/KDE/Administrative+Resources/Technology/Technology+Architectural+Policies+and+Standards/Architectural+Standards+Committee.htm

Unmet Need Standards and Policies

Unmet Need Standards represent the equitable baseline of all technology components required to adequately address both the instructional and administrative needs of K12. These standards are derived from two separate by complimentary criteria:

- **Component Ratios** (Quantities) – Baseline minimum ratios for each technology component have been established based on average daily attendance, total number of schools, total number of teachers, or total number of classrooms. It is the expectation that all districts maintain these minimum ratios to effectively address equitable ease of access for all instructional and administrative activities.

- **Component Standards** (Products) – All published architectural standards and associated products are considered KETS Standard Components.

Any technology procured or secured by a district, in a category for which a Kentucky Education Technology System unmet need standard is established, regardless of whether the item is used to reduce the unmet need or not, must meet or exceed the KETS standard in compliance with 701 KAR 5:110.

Any technology procured or secured by a district, in a category for which a Kentucky Education Technology System unmet need standard is established, regardless of whether the item is used to reduce the unmet need or not, must be included in the District Technology Plan as inventory.

Technology secured through local initiative which is not procured with public revenues will not be used to reduce the unmet need of the district for the purpose of calculating the amount of offers of assistance for which the district is eligible.

Technology procured with federal categorical funds will not be used to reduce the unmet need of the district for the purpose of calculating the amount of offers of assistance for which the district is eligible.

Statutory Authority and Responsibility

The Master Plan for Education Technology

Standards
KRS 156.160(1) stipulates that the Kentucky Board of Education has a statutory mandate to prescribe standards, which school districts shall meet. Among these are standards for the "acquisition and use of educational equipment for the schools as recommended by the Council for Education Technology" (KRS 156.160(1)(b).

The statutes do not restrict the standards-setting responsibilities noted above to any particular source of funds. The Kentucky Board of Education, therefore, has the authority and obligation to specify standards for education technology to which school district acquisitions of hardware and software are subject regardless of source of funds. The board may specify, as it deems necessary, a standard for any line item in the Master Plan budget.

These standards are set forth in the Master Plan for Education Technology and incorporated by reference into Kentucky Administrative Regulations (KARs) pursuant to 701 KAR 5:110 and in compliance with KRS 156.160(1).

Districts are required by 701 KAR 5:110 to procure only those technologies that meet KETS standards, if a standard for that category has been established, regardless of source of funds.

Education Technology Trust Fund

The Education Technology Trust Fund is established in the Finance and Administration Cabinet by KRS 157.665(1) to provide education technology for the public school system.

Funds are appropriated to the trust fund in each biennial budget. All interest earned on money in the fund is retained for reinvestment in the fund. All money credited to the fund, including interest, is to be used for education technology as defined by the Kentucky Board of Education's Master Plan and does not lapse (KRS 157.665(2)).

The School Facilities Construction Commission, within the Finance and Administration Cabinet, is responsible for distributing state funds to local districts through the education technology-funding program (KRS 157.650).

To participate in the education technology funding program, a local public school district must have an unmet technology need described in the district plan and approved by the Kentucky Board of Education (KRS 157.655(1)).

The base level of assistance to each district is determined by dividing the total amount available in the trust fund by the total of the prior year's average daily attendance of the eligible districts times the individual district's prior year's average daily attendance (KRS 157.660(1)).

Funds transferred to districts are to be used only for the projects included in the district's plan (KRS 157.660(2)).

Trust funds are transferred to local districts after the district's need for assistance has been certified by the School Facilities Construction Commission. All other expenditures from the fund require the approval of the Kentucky Board of Education (KRS 157.655(3)).

Calculation of Unmet Need
Any technology procured or secured by a district, in a category for which a KETS unmet need standard is established, regardless of whether the item is used to reduce the unmet need or not, must meet or exceed the KETS standard in compliance with 701 KAR 5:110.
Any technology procured or secured by a district, in a category for which a KETS unmet need standard is established, regardless of whether the item is used to reduce the unmet need or not, must be included in the District Plan as inventory.

Approval of the unmet need amounts for local school districts is the first step required to allow local school districts to receive state funding to assist them in funding hardware, software, personnel, professional development and other technology initiatives that will support students in achieving academic excellence and reaching proficiency by 2014.

Staff certify that the districts recommended by the Commissioner of Education have met all the statutory requirements of KRS 157.655 and KRS 157.660 and will be required to adequately describe their unmet need and current KETS inventory before Offers of Assistance are distributed.

The following must occur before a district receives it's funding:

1. Kentucky Board of Education approves unmet need for districts.

2. School Facilities Construction Commission (SFCC) approves unmet need.

3. The district successfully meets all of the statutory requirements of KRS 157.655 and KRS 157.660.

4. The district verifies its final ADA count to KDE's Division of School Finance.

5. KETS staff calculates Offers of Assistance based on these variables.

The districts must follow requirements of the SFCC by receiving approved board action and proof of deposit of funds into a local interest bearing technology account. The SFCC will then wire funds to the district's technology account.

There are four categories of unmet need: operations; maintenance; incremental replacement; and new technologies.

Expenditures in **operations and maintenance** are absolutely necessary to sustain current levels of service. If unmet need within the operations and maintenance categories is not addressed in accordance with program guidelines, the integrity, sufficiency and capacity of the district technology infrastructure will degrade until services are seriously curtailed or eliminated. These include items such as student workstation repair, teacher workstation repair, instructional software improvements, classroom printer repair, instructional fileserver repair, school management software improvements, initial/ongoing technology integration, professional development, student technology leadership services, Internet services, telephone communications to parents, distance learning service, help desk services, e-mail services, enterprise data system access and school financial management services.

The unmet need for **incremental replacement** constitutes a framework for replacement of various technology components on a scheduled basis over time, in accordance with the life cycle of each item or service. These include items such as student workstations, teacher workstations, instructional fileservers, assistive and adaptive technology, school laser printers, classroom color printers, wireless networks, student hand-held devices, high-speed fiber networks, desktop conferencing and digital projection devices.

The unmet need for **new technologies** includes products and services that are more discretionary in nature, products and services that are today only marginally available or affordable and products and services that are perceived as needs in the planning horizon.

The Kentucky Board of Education will acknowledge and approve the unmet need for each district. In the KETS Implementation Plan, the board also will be considering approval of the amount of funds available to go toward that unmet need. Districts must continue to secure alternative funding sources beyond the KETS funds, using federal funds, local grants or other sources, to fully fund the unmet need. Budgeting skills will be required to sustain and implement Phase III of KETS.

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[1] This includes modifications of systems in existing building (duct work and/or separate zoning)
[2] Older systems that are updated/modified and not covered by telephone intercom systems

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- – Lunch Box Card Reader
- – Video Security
- ○ Electrical
  - ▪ Campus Wide Lighting Control
  - ▪ Marquee Sign
- ○ Data Facilities
  - ▪ Wiring Closets (MDF and/or IDF)
    - – Racks
    - – Distribution/Patch Panels
    - – Fixed Cabinets
    - – De-Humidifiers
    - – Static Suppression
    - – Water sensors
    - – Network Switches
  - ▪ UPS
    - – Rack Mounted
    - – Data Center Free Standing
    - – Surge Suppression
    - – Back up Generator
  - ▪

10. Appendices
    - ○ KETS Standards

BUILDING and WIRING DESIGN CHECKLIST

Version 3.0   March 26, 2008

Background Data:

Date Requesting _____

District Name _____

School Name _____

School Size (ADA) _____

Number of Classrooms _____

Number of Student data drops _____

Number of teacher drops Voice _____ Data _____ Video_____

Number of Wiring closets CDF _____ MDF _____ IDF _____

Number of Shared resource Data drops (Fileservers, Printers, etc…) _____

(Circle or highlight one below)

New Construction   Renovation / Addition
Additional Wiring (for existing LAN)   Replacement / Update

Amount of EDTECH FUNDS requesting $ _____

Using LOCAL FUNDS only? Y or N (circle or highlight one)

List each item with description and amount. (Use separate sheet if needed or Excel worksheet):

List items that don't meet full KETS standards (use separate sheet if needed)

Existing cable systems in building:

Data cable type _____ (UTP, Coax, Token Ring Type 1,2,3)

Data connectors type _____

Fiber and connectors type _____

Video Cable and connectors type _____

Voice Cable and connectors type_____

Voice or Data Punch Down/Patch Panel blocks type_____

Voice, Data, or Video Layout diagrams available?

Using existing Data, Voice, and Video Distribution systems?

List type of distribution system (e.g. conduit, ducts, O-rings, ladders):

Existing Distributions Diagrams available to Engineer? Y or N

Existing Voice System?

Electrical Layout Diagram available to Engineer?

Mechanical Layout Diagram available to Engineer?

Campus or Single Building network design?

Checklist Data (Use separate sheet if needed):

All items shall be answered in a legible format. If an item does not apply it must be identified as "not applicable" or "this does not apply to the scope of this work".

All original signatures must be acquired and submitted with this document.

This document serves as a scope of work for the identified project. It should be indicated for every item exactly how this particular issue will be implemented and how this meets KETS standards. Do not turn in a replication of the Building Wiring Explanation but in your own words describe the implementation and any deviation with justification.

1. Statement addressing KETS standards:

2. Plenum Cable Required? _____

3. Maximum CAT 6 or better UTP Cable lengths for this project:

4. Backbone Distribution Data, Voice, Video (lowest common rate):

5. Horizontal and Vertical, including Ceiling and Under Floor Distribution for Data, Voice, and Video Cabling (Data Center):

6. Ceiling and Under Floor Distribution:

7. Riser Access:

8. D-Mark Entry Points:

9. Building to Building (Campus) or Fiber wiring (Single or Multi-mode Connectors):

10. Data Drops to a Room:

11. Conduit Size:

12. Drilling through walls or support structures (Fire Code):

13. Power considerations:

14. EMI considerations:

15. Distribution Frame (DF) Characteristics/Equipment:

16. Distribution Frame Room (Ventilation HVAC, Fire Suppression):

17. Mounting Equipment:

18. Punch Down Block:

19. Block Arrangement:

20. Cable labeling:

21. Testing Activities:

22. Documentation:

23. Qualified Designers:

Signatures (I verify the above data is valid to the best of my ability):

Design contractor _____   Date _____

Printed name _____

CIO _____   Date_____

Printed Name _____

KRE Review   _____   Date_____

OET Review _____   Date_____

Classroom

Classification: New Structure, Renovation

Item: Fixed Interactive Whiteboard Systems – used for presentation and instruction

- Hardware

- All systems must be at least 64" for a classroom size of 25 students.

- All systems must have Wall mounts bracket, desktop stand or floor stand on wheels.

- All systems must have replacement pens on hand should one fail or be lost to reduce downtime and Total cost of ownership.

- All systems must have glare prevention to minimize eye strain.

- All systems must have touch-sensitive basic operation to use without the benefit of special pens.

Administrative Items to be considered:

Software

1. Vendors must include software and free, online upgrades.

2. Software must be available for Windows and Macintosh.

3. Network administrator must be able to perform a silent installation of the interactive whiteboard software.

Types of Projection Displays

1. **Front Projection** - Projector sits in front of the whiteboard and projects the computer image on the whiteboard. The projector can sit on the table or mount on the ceiling.

2. **Rear Projection** - Projector is mounted behind the whiteboard and a series of mirrors project the image on the screen.

3. **Overlay for Flat-Panel Plasma Display** - A plasma screen overlay is a device that fits over a plasma screen. Plasma screens which have an interactive overlay on them work in exactly the same way as interactive whiteboards

Funding Sources:

KETS (S/L), Local (L), Facilities (F)

Related Documents:

- [Interactive White Board Standard](#)

Classroom

Classification: New Structure, Renovation

Item: Projector(s) – Presentation and Instruction Device

Hardware

 There are three platforms to consider

1. **Fixed** - **Fixed Data/Home Theater Projectors:** A projector weighing 10 lbs or greater and intended for fixed installations supporting medium to large classrooms, conference rooms, and auditoriums.

    A) **Display Technology:** A portable projector will most likely be found in triple chip LCD and Single Chip DLP configurations. Triple chip LCD mobile projectors will cost less than single chip DLP projectors in most cases.

        1) Triple Chip LCD

        2) Triple Chip DLP

        3) LCOS (AKA :Poly Silicon)

        4) CRT (The price of CRT projectors will limit installations to large auditoriums)

    B) **Aspect, Contrast Ratio and Lumens:** A fixed projector will be driven by the type of content/data to be projected. Expect the added cost of an A/V switch or dedicated A/V rack when installing a fixed projector. A professional A/V rack will include built rack mounted DVD, VCR, PC and ports for other input and output devices, think surround sound. A minimum contrast ratio of 700:1 for a fixed projector will be fine for most uses. The amount of lumens needed in the fixed category of projectors will depend on the setting the projector will be used in. Fixed projectors will typically be anywhere from 2000 – 4000+ Lumens.

        1) 4:3, 5:4, 16:9 and 16:10 Aspect Ratio

        2) 700:1 - 2000:1 Contrast Ratio

        3) 2500 – 4000 Lumens

    C) **Display mode and Resolution:** The display mode of the projector will be dictated by the input device such as a multiple computers, laptop, PDA, UMPC, TV, DVD/VCR, Set Top Box and video conferencing hardware.

        1) XGA for a standard definition (400i), aspect ratio of 4:3 at 1024X768

        2) WXGA for a high definition (720p), aspect ration of16X9 or 16:10 at 1280×720 or 1280x800

        3) WSXGA or WXGA+ for a high definition (exceeds 720p), aspect ratio of 16:10 at 1440×900

2. **Mobile Projectors:** Projector weighing less than approximately 5lbs[3] and intended for mobile presentations or sharing of projector equipment in small offices and classrooms.

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[3] Weight is used for the purposes of helping to define type or flavor (mobile, portable, etc.) of projector.

A) **Display Technology:** A mobile projector will be easiest to find in a LCD configuration and will be much cheaper than a similarly sized DLP projector. Most mobile projectors weight and cost considerations dictate a single chip LCD.

1) Single chip or Triple Chip LCD

B) **Aspect, Contrast Ratio and Lumens:** The aspect ratio of a mobile projector will be driven by the type of content/data to be projected. s. A minimum contrast ratio of 300:1 for a mobile projector will be fine for most uses.

1) 4:3 or 16:10 Aspect Ratio

2) 300:1 - 800:1 Contrast Ratio

3) 800 – 1500 Lumens

3. **Portable Projectors:** A projector weighing 5lbs or greater and intended for portable presentations or sharing of projector equipment in medium to large classrooms, conference rooms, and auditoriums.

A) **Display Technology:** A portable projector will most likely be found in triple chip LCD and Single Chip DLP configurations. Triple chip LCD mobile projectors will cost less than single chip DLP projectors in most cases.

1) Triple Chip LCD

2) DLP Single Chip or Triple Chip

B) **Aspect, Contrast Ratio and Lumens:** As with mobile projectors the aspect ratio of a portable projector will be driven by the type of content/data to be projected. Many portable projectors will support 4:3 natively and 5:4 and16:9 digitally. Portable projectors will typically be anywhere from 1500 – 2500+ Lumens.

1) 4:3, 5:4, 16:9 and 16:10 Aspect Ratio

2) 600:1 - 2000:1 Contrast Ratio

3) 1500 – 2500 Lumens

C) **Display mode and Resolution:** The display mode of the projector will be dictated by the input device such as a computer, laptop, PDA, UMPC, TV, DVD/VCR.

1) XGA for a standard definition (400i), aspect ratio of 4:3 at 1024X768

2) WXGA for a high definition (720p), aspect ration of16X9 or 16:10 at 1280×720 or 1280x800

3) WSXGA or WXGA+ for a high definition (exceeds 720p), aspect ratio of 16:10 at 1440×900

Funding Sources:

KETS (S/L), Local (L), Facilities (F)

Related Documents:

- Projector Standard

Workstations

Classification: New Structure, Renovation, or Addition

Item: Workstation Minimum Standards

- Hardware
  - There are two standards of workstations (Stationary and Portable Units).
  - The standards are broken into levels and will contain technical specifications for the following components/areas:

• Processor	• Cache	• Video
• Installed memory	• Slots	• Graphic Support

• Memory Slots
  ▪ Desktop
    ▪ Level 1 – 2 Slots
  ▪ Laptop
    ▪ Level 1 – 1 Slot
  ▪ Tablet
    ▪ 1 Available
	• Hard Drive
	  ▪ Desktop
	    ▪ Level 1 – 40 GB SATA 7200 RPM
	    ▪ Level 2 & 3 – 80 GB SATA 7200
	  ▪ Laptop
	    ▪ Level 1 - 30 GB
	    ▪ Level 2 - 40 GB
	    ▪ Level 3 - 60 GB
	  ▪ Tablet
	    ▪ 40 GB Hard Drive
		• Ports
		  ▪ VGA Graphics
		  ▪ Keyboard PS/2 or USB
		  ▪ Mouse

• Memory Expansion Capability	• Sound Card	• Universal Serial Bus (USB)

• CD\Rom
  ▪ Internal Drive
  ▪ Plug & Play Compliance with OS
  ▪ Sound Compatibility with Soundcard
	• Input device
	  ▪ 101 Key Keyboard
	  ▪ 1 Button Optical Mouse
		• Operating system
		  ▪ Windows XP PRO

• Drivers - Installed
  ▪ Network Interface
  ▪ CD\Rom
  ▪ Hard Disk
  ▪ Modem
  ▪ Video
	• Network
	  ▪ Ethernet 10/100/1000
	  ▪ Visual LEDs
	  ▪ Automatic Sensing
	  ▪ Internal Wireless
	  ▪ Plug & Play Compatible with OS
		• Expandable Internal Bay

• Battery
  ▪ Usage
  ▪ Recharge
	• Modem
	  ▪ Credit card – Dial up network with OS
	  ▪ 55#s/call
		• Support plug and Play devices

• Display	• Laptop carry case	• Energy Star Compliance

• Warranty – 3 year
  ▪ On-site
  ▪ Depot with Accidental Coverage		

- **Stationary Workstation Units (Desktops)**
  - There are three levels
    - Level 1 – Economy

- Level 2 – Standard
- Level 3 – Enhanced

- **Portable Workstations Units (Laptops)**
  - Level 1 – Economy
  - Level 2 – Standard
  - Level 3 – Enhanced
  - Tablets
  - Mini Devices

Administrative Items to be considered:

Funding Sources:
KETS (S/L), Local (L)

Related Documents:

1. PC
   - [Desktop Standard Spec](#)
   - [Laptop Standard Spec](#)
2. Apple
   - [Desktop Standard Spec](#)
   - [Laptop Standard Spec](#)

Server

Classification: New Structure, Renovation, or Addition

Item: Server Specifications

- Hardware
  - The Server standard processor will be Intel.
  - Server standards are broken into multiple levels and will contain technical specifications for the following components/areas:

• Processor	• Cache ▪ 512 L2 Cache minimum	• Video ▪ 4 MB minimum built in ▪ 1024x768 min resolution
• Installed memory ▪ Minimum 1 GB	• Hard Drive ▪ 36 GB minimum	• Power Supply
• Memory Slots	• Hard Drive Controller	• Fans
• Memory Expansion Capability ○ Levels 1 & 2 • Up to 4 GB of RAM ○ Levels 3 • Up to 8 GB of RAM ○ Level 4 • Up to 4 GB of RAM ○ Level 5 • Up to 8 GB of RAM.	• Physical Internal Storage ○ Minimum Drive Bays ▪ Level 1 – 3 Bays ▪ Level 2 – 6 Bays ▪ Level 3 – 10 Bays ▪ Level 4 – 2 Bays ▪ Level 5 – 4 Bays	• Server Footprint ▪ Level 4 – Must be 1U server ▪ Level 5 – Must be 2U server
• Internal DVD Rom ▪ 8x DVD	• Keyboard ▪ USB Interface	• Mouse ▪ USB Interface
• System Bus ▪ Minimum PIC/PCIX/PCI Express ▪ Level 1 – 4 Slots ▪ Level 2 – 5 Slots ▪ Level 3 – 6 Slots ▪ Level 4 & 5 – Minimum 2 slots before External SCSI or Remote Management Access card	• Rackmountable ○ Levels 1,2 & 3 • Capable ○ Level 4, 5 & 6 • Must come rack-mount ready.	• Network ▪ Must demonstrate visual LEDs to show link integrity and activity ▪ Must have automatic sensing and reconfiguration for the speed of the hub or switch port ▪ Must support category 5e UTP
• Remote Management Access ▪ Level 4 & 5 – Add on PCI or Built-in	•	•

  - Server levels are listed by three configurations
    - Tower (each capable of being Rackmountable with a minimum of 3 USB ports)
      - Level 1
      - Level 2
      - Level 3
    - Rack Mount Ready with a minimum of 2 USB ports) They also must come rack-mount ready with all rack mount rails, etc. which are specific to server manufacturer.

- Level 4 – 1U

- Level 5 – 2U

Administrative Items to be considered:

Funding Sources:
KETS (S/L), Local (L)

Related Documents:
Server Standard

Wiring

Classification: New Structure, Renovation, or Addition

Item: All Data, Voice, Video Wiring and Substructure

1.   Follow all recommendations per COT wiring standards for data, voice, audio/video and electrical
     a.   Cable installation based on industry standards. The following are applicable:
          1.   EIA/TIA-568 Commercial Building Telecommunications Wiring Standard and its appendix, TSB67 level 2, Testing Standard
          2.   EIA/TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces
          3.   EIA/TIA-570 Residential and Light Commercial Telecommunications Wiring Standard
          4.   EIA/TIA-606 Administrative Standard for the Telecommunications Infrastructure of Commercial Building
          5.   EIA/TSB-36 Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables
          6.   EIA/TSB-40 Additional Transmission Specifications for Unshielded Twisted Pair Connecting Hardware
          7.   FCC Docket 88-57 and related rules regarding inside wire and demarcation points.
          8.   IEEE 802.3 Specification
          9.   IEEE 10BaseT Specification

2.   Follow all local/state wiring codes and restrictions
     a.   KY State Building Codes URL: http://dhbc.ky.gov/

3.   Wiring Network Designs and Tests
     a.   All CIO's should receive a copy of network drawings and test results as part of construction projects

Administrative Items to be considered:
- Plan for future in current design
  - Size conduit for additional runs or new wire sizes
  - Growth or contraction of student or staff users
  - Growth or contraction of Data Center/wiring closets
  - Cable guides and ladder racks
- Minimum data wire size (10/100/1000) (fiber/10gbt)
  - Single mode fiber exterior runs (minimum)

- ▪ Multi mode fiber for interior runs (minimum)
- ▪ Category 6 minimum for copper (10/100/1000)
- • Fire suppression in Data Centers/wiring closets
  - ▪ Removal of water source
  - ▪ Dry suppression system recommended (i.e. intergen)

Funding Sources:
KETS (S/L), Local (L), Facilities (F)

Related Documents:

APPENDICES

Interactive White Board Standard

Purpose and Scope: Create a standard document with specifications for interactive White Boards that will apply to all Kentucky School Districts.

Reason for Implementing: To create a technical standard to ensure districts purchase interactive white boards that will meet current and future needs for presentation and instruction.

Standard of the Interactive Whiteboard

1. All systems must be at least 64" for a classroom size of 25 students.

2. All systems must have Wall mounts bracket, desktop stand or floor stand on wheels.

3. All systems must have pens with non-mechanical parts and the ability to use the system without pens to reduce downtime and Total cost of ownership.

4. All systems must have glare prevention to minimize eye strain.

5. All systems must have touch-sensitive basic operation to use without the benefit of special pens.

6. Vendors must include software and free, online upgrades.

7. Software must be available for Windows and Macintosh.

8. Software must be able to convert handwritten notes to text.

9. Software must be able to save text directly into applications such as Word and Excel.

10. Software must be able to save notes in different file formats for easy sharing.

11. Software must be able to edit, erase or rearrange order of notes

12. Must be able to record all on-screen activity (whether in the interactive whiteboard software, or any other application, or on the desktop) and audio as a digital video file.

    a. Must be able to choose to record the full screen, a window or a specified area.

13. Network administrator must be able to perform a silent installation of the interactive whiteboard software.

14. Software content collection includes learning objects including clip-art images, backgrounds, videos, audio clips, Macromedia® Flash® files, and interactivities.

Major Types of Interactive Whiteboards

1. **Front Projection**: In front projection interactive whiteboards, the projector sits in front of the whiteboard and projects the computer image on the whiteboard. The projector can sit on the table or mount on the ceiling.

a. Cost less than the rear projection interactive whiteboards and plasma overlays.

b. A drawback is that when the presenter stands in front of the whiteboard, he casts a shadow on the screen and has to look into the projector light.

c. Projectors used with interactive whiteboards have an average of 2,000 hours lamp life and lamps for most projectors are costly to replace.

2. **Rear Projection**: In rear projection interactive whiteboards, the projector is mounted behind the whiteboard and a series of mirrors project the image on the screen.

a. The advantage of rear projection over front projection is that the presenter doesn't have to look into the projector light when speaking to the audience and the presenter also doesn't cast a shadow on the board.

b. The disadvantage is that these systems are usually 5 times more expensive than front projection whiteboards.

c. They also take up more room as the back is bulkier due to housing the projector. However, there is also room in the cabinets for a computer base-unit; video recorder/DVD player and many have cable management systems for connecting to visiting laptop computers.

d. In-wall systems are also available where the rear-projection whiteboard is built-into a wall that has an area behind it to house the projector. Partition walling, i.e. a false wall, is usually used.

3. **Overlay for Flat-Panel Display**: A plasma screen overlay is a device that fits over a plasma screen. Plasma screens which have an interactive overlay on them work in exactly the same way as interactive whiteboards

a. plasma screen is a large widescreen monitor, from 32" to 84" in size,

b. Advantage of being very thin so that it can be hung on walls.

c. Can be used with computers and video recorders/DVD players etc.

d. The advantage of using a plasma screen is that a shadow is not cast by the presenter, unlike front projection interactive whiteboards.

e. Lifespan of around 30,000 hours use.

f. Disadvantage with the plasma screen is the screen size and the high price.

g. Gives a far neater finish in a board room environment and far superior pictures when using video recorders, satellite systems or DVD players to show television or video.

Related Documents:
http://www.theteachersguide.com/SmartBoards.htm

References:

PROJECTORS

Purpose and Scope: To create a technical standard to ensure districts purchase projectors that will meet current and future needs for presentation and instruction.

1. **Mobile Data/Business Projectors:** A projector weighing less than approximately 5lbs[4] and intended for mobile presentations or sharing of projector equipment in small offices and classrooms.

    A) **Display Technology:** A mobile projector will be easiest to find in a LCD configuration and will be much cheaper than a similarly sized DLP projector. Most mobile projectors weight and cost considerations dictate a single chip LCD.

        1) Single chip or Triple Chip LCD

    B) **Aspect, Contrast Ratio and Lumens:** The aspect ratio of a mobile projector will be driven by the type of content/data to be projected. If you will project using a standard laptop or desktop computer expect to project at 4:3 if you are going to be projecting movies or from a wide screen laptop expect to project at 16:10 in most cases. A minimum contrast ratio of 300:1 for a mobile projector will be fine for most uses. The amount of lumens needed in the mobile category of projectors will depend on the setting the projector will be used in. The more the better isn't always true. If the projector in question has a higher contrast ratio and the room the projector is being used in has easily controlled ambient light then lower lumens are fine. Mobile projectors will typically be anywhere from 1000 – 2000 Lumens.

        1) 4:3 or 16:10 Aspect Ratio

        2) 300:1 - 800:1 Contrast Ratio

        3) 800 – 1500 Lumens

    C) **Display mode and Resolution:** The display mode of the projector will be dictated by the input device such as a computer, laptop, PDA, UMPC, TV, DVD/VCR.

        1) XGA for a standard definition (400i), aspect ratio of 4:3 at 1024X768

        2) WXGA for a high definition (720p,) aspect ration of16X9 or 16:10 at 1280×720 or 1280x800

    D) **Lens Throw:** Projection distance will be dictated by the size of the room in which the projector will be used.

        1) The average class room and conference room should be able to handle almost any mobile projector's lens throw.

        2) Small offices and small conference rooms should consider utilizing a projector with a short throw lens option.

    E) **Other Considerations:** Please take the following other items under consideration when selecting a mobile projector.

        1) Mobile projectors are just that; mobile, moving around a lot and traveling in lap top bags.

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[4] Weight is used for the purposes of helping to define type or flavor (mobile, portable, etc.) of projector.

2) Place emphasis of security on the user's ability to keep up with the projector rather than purchasing physical locks.

3) Create a mobile projector kit that goes with the projector in its own case. The kit would include all necessary cables, remote, extra bulb and users cheat sheet to get up and running quickly. Don't forget to check the contents of the kit when the projector is checked back in.

4) There are some mobile projectors that offer wireless networking. These projectors will allow you to project presentations with out wires. The laptop that you will be projecting from must have either a built in wireless card or a wireless PC card. The card could be kept in the projector kit as well.

5) Projector noise and heat are not as much of a concern with smaller mobile projectors as long as there is good ventilation and low ambient noise in the room it is being used in.

2. **Portable Data/Home Theater Projectors:** A projector weighing 5lbs or greater and intended for portable presentations or sharing of projector equipment in medium to large classrooms, conference rooms, and auditoriums.

A) **Display Technology:** A portable projector will most likely be found in triple chip LCD and Single Chip DLP configurations. Triple chip LCD mobile projectors will cost less than single chip DLP projectors in most cases.

1) Triple Chip LCD

2) DLP Single Chip or Triple Chip

B) **Aspect, Contrast Ratio and Lumens:** As with mobile projectors the aspect ratio of a portable projector will be driven by the type of content/data to be projected. If you will project using a standard laptop or desktop computer expect to project at 4:3 if you are going to be projecting movies or from a wide screen laptop expect to project at 16:10 in most cases. If you will be projecting from a DVD player you should expect to see a true16:9 aspect ration on wide screen movies. Many portable projectors will support 4:3 natively and 5:4 and16:9 digitally. A minimum contrast ratio of 600:1 for a mobile projector will be fine for most uses. The amount of lumens needed in the portable category of projectors will depend on the setting the projector will be used in. As with the mobile projectors the more the better isn't always true. If the projector is question has a higher contrast ratio and the room the projector is being used in has easily controlled ambient light then lower lumens are fine. Portable projectors will typically be anywhere from 1500 – 2500+ Lumens.

1) 4:3, 5:4, 16:9 and 16:10 Aspect Ratio

2) 600:1 - 2000:1 Contrast Ratio

3) 1500 – 2500 Lumens

C) **Display mode and Resolution:** The display mode of the projector will be dictated by the input device such as a computer, laptop, PDA, UMPC, TV, DVD/VCR.

1) XGA for a standard definition (400i), aspect ratio of 4:3 at 1024X768

2) WXGA for a high definition (720p), aspect ration of16X9 or 16:10 at 1280×720 or 1280x800

3) WSXGA or WXGA+ for a high definition (exceeds 720p), aspect ratio of 16:10 at 1440×900

D) **Lens Throw:** Projection distance will be dictated by the size of the room in which the projector will be used.

    1) The medium to large class room and conference room should be able to handle almost any portable projector's lens throw.

    2) Large conference rooms, class rooms and auditoriums should consider utilizing a fixed projector with a long throw lens option.

E) **Other Considerations:** Please take the following other items under consideration when selecting a mobile projector.

    1) Portable projectors are meant for the purposes of temporary location or easy storage in conference rooms or classes that have desk space issues but can't afford to purchase a fixed mount projector.

    2) Place emphasis of security on optionally purchased physical locks or locked storage. Portable projectors are usually twice the cost of mobile projectors.

    3) Create a portable projector cart that easily allows for the projector to be moved from room to room. The cart would include all necessary cables, remote, extra bulb and users cheat sheet fastened to the cart. The projector can be physically cable locked to the cart. Don't forget to check the contents of the cart when the projector is checked back in.

    4) There are some portable projectors that offer wired and wireless networking. These projectors will allow you to project presentations with out wires or monitor there usage of the LAN. The laptop that you will be projecting from must have either a built in 10/100 Ethernet port, wireless card or a wireless PC card. The card could be kept in the projector kit as well.

    5) Projector noise and heat can be a concern with the larger portable projectors. As long as there is good ventilation and low ambient noise in the room it is being used in there should be no problems. Please be advised that some portable projectors now come with added filters that must be changed out just like your car.

3. **Fixed Data/Home Theater Projectors:** A projector weighing 10lbs or greater and intended for fixed installations supporting medium to large classrooms, conference rooms, and auditoriums.

  A) **Display Technology:** A portable projector will most likely be found in triple chip LCD and Single Chip DLP configurations. Triple chip LCD mobile projectors will cost less than single chip DLP projectors in most cases.

    1) Triple Chip LCD

    2) Triple Chip DLP

    3) LCOS (AKA :Poly Silicon)

    4) CRT (The price of CRT projectors will limit installations to large auditoriums)

  B) **Aspect, Contrast Ratio and Lumens:** As with mobile and portable projectors the aspect ratio of a fixed projector will be driven by the type of content/data to be projected. If you will project using a standard laptop or desktop computer expect to project at 4:3 if you are going to be projecting movies or from a wide screen laptop expect to project at 16:10 in most cases. If you will be projecting from a DVD player you should expect to see a true16:9 aspect ration on wide screen movies. Expect the added cost of an A/V switch or dedicated A/V rack when installing a fixed

projector. A professional A/V rack will include built rack mounted DVD, VCR, PC and ports for other input and output devices, think surround sound. A minimum contrast ratio of 700:1 for a fixed projector will be fine for most uses. The amount of lumens needed in the fixed category of projectors will depend on the setting the projector will be used in. As with the mobile and portable projectors the more the better isn't always true. If the projector is question has a higher contrast ratio and the room the projector is being used in has easily controlled ambient light then lower lumens are fine. Fixed projectors will typically be anywhere from 2000 – 4000+ Lumens.

1) 4:3, 5:4, 16:9 and 16:10 Aspect Ratio

2) 700:1 - 2000:1 Contrast Ratio

3) 2500 – 4000 Lumens

C) **Display mode and Resolution:** The display mode of the projector will be dictated by the input device such as a multiple computers, laptop, PDA, UMPC, TV, DVD/VCR, Set Top Box and video conferencing hardware.

1) XGA for a standard definition (400i), aspect ratio of 4:3 at 1024X768

2) WXGA for a high definition (720p), aspect ration of16X9 or 16:10 at 1280×720 or 1280x800

3) WSXGA or WXGA+ for a high definition (exceeds 720p), aspect ratio of 16:10 at 1440×900

D) **Lens Throw:** Projection distance will be dictated by the size of the room in which the projector will be used.

1) The large conference room and auditorium should be able to handle almost any fixed projector's lens throw.

2) Large conference rooms, auditoriums should consider utilizing a fixed projector with a long throw lens option.

E) **Other Considerations:** Please take the following other items under consideration when selecting a mobile projector.

1) Fixed projectors are meant for the purposes of fixed locations in conference rooms or auditoriums where large groups of people will gather for presentations utilizing one or more media sources.

2) Place emphasis of security on optionally purchased physical locks and ceiling mounts. Fixed projectors are usually three to four times the cost of portable projectors.

3) Store remote(s) and users cheat sheet with the AV switch or Locked AV Rack. Better yet; assign some one in facilities to provide set ups for all scheduled presentation activities.

4) Most fixed projectors offer wired and wireless networking. These projectors will allow you to project presentations with out wires or monitor there usage on the LAN. Some projectors can even page someone in IT that the filter or bulb needs to be changed. The laptop that you will be projecting from must have either a built in 10/100 Ethernet port, wireless card or a wireless PC card. Most connectivity to fixed projectors will happen at the AV switch or AV Rack.

5) Projector noise and heat can be a concern with the larger fixed projectors. As long as there is good ventilation and low ambient noise in the room it is being used in there

should be no problems. Please be advised that some fixed projectors now come with added filters that must be changed out just like your car.

Acronyms/Abbreviations:

Projector Category	
	Front Projector/Projection - refers to a projector that is in front of a screen where as rear projection more often than not refers to large wide screen TVs where a projector in the rear of the TV is providing video. All products included in the document should be considered Front Projection Projectors.
	Data/Business Projector - are projectors that are usually mobile/portable in nature and often thought of as being associated with computers. Data projectors are not limited to slide presentations and are capable of displaying video feed at various resolutions.
	Home Theater Projector - are projectors usually associated with movies but can be just as capable to display computer images. Home theater projectors can be as inexpensive as 400.00 or as expensive as 30,000.00. Basically when it come to home theater the skies the limit. Home theater projectors often will have more connection and configuration options over a Data/Business Projector.
	Fixed - are projectors that are large enough for medium to large conference spaces and auditoriums that must be attached permanently. Permanent attachment is considered when the projector is a dedicated piece of AV equipment associated with a room that has a fixed screen and audio system.
	Portable - are projectors that may be moved around from conference room to conference room within a facility. Portable projectors may also serve as a permanent projector within a given room but still needs to be moved occasionally with in that room.
	Mobile - are projectors that travel along side mobile workers and should be able to fit into a laptop bag and usually weighing 3lbs or less.
	Pocket - an emerging technology that applies the use of a very small projector to the handheld and mobile computing platforms. These projectors are not readily available and many manufacturers are promising shipments in 2007-2008. Think about UMPC when considering a pocket projector. Among the fundamental problems with ever-shrinking mobile phones, personal digital assistants, digital cameras, and other portable devices is that they carry more and more of our data, but they are decreasing in size such as to make them inconvenient to use in certain respects. Building tiny projectors into these devices may offer a practical solution. Research teams have developed miniature hardware and software that can project digital images onto whatever surface is handy—the wall, say, or a desktop—and make them look good even if the impromptu screen isn't nice and smooth.
Display Technology	

CRT/Cathode Ray Tube - This is the largest and most experienced player. Many of you have probably seen this kind of projector at a sports bar or in an auditorium at a school. CRT utilizes three tubes, sometimes called 'guns.' The three colors combine or converge to make your image. CRTs do not have a fixed number of pixels, making them versatile machines capable of clear images from higher or lower resolution sources. CRTs also require periodic 'calibration' by a trained professional, which can mean additional expense for the end user down the road. These projectors are generally used in fixed installations because of their size. CRTs are typically not as bright as the other technologies, but the refined picture quality of a properly calibrated CRT is tough to beat.

LCD - LCD projection technology is the current leader of the pack, having captured the majority of the market share of all projectors sold. Most LCD projectors have three panels. Each panel is a prism that allows blue, red, or green light through its pixels. These separate colors are then converged and projected. Electrical signals turn on pixels within a set based on the resolution of the unit. LCDs are known to produce greater color definition, offering more shades or variations of color than single-chip DLP™ projectors. DLP™ projectors can sometimes burn definition out of the highlights and shadows with their vibrant colors. Newer LCD projectors include special optics enhancers like micro-lens array that minimize pixelization known as the "screen door effect." New LCD projectors have contrast ratios as high as 800:1. By comparison, DLP™ projectors contrast ratios are as high as 3000:1. The portability and brightness of LCD projectors have made them a popular choice for traveling presenters. The lightest LCD projectors weigh-in at about 4 lbs.

3LCD/Triple Chip LCD In early 2006 three-panel/triple chip LCD projectors were significantly cheaper than three-chip DLP projectors. In part because of the rainbow effect that some viewers experience with single chip DLP projectors three chip/panel LCD projectors are considered better than single chip/panel LCD and DLP projectors for TV and home cinema**.**

DLP™ (single chip) - Digital Light Processing
The single-chip DLP™ is the most portable of all our players. Currently you can find single-chip DLP™ projectors that weigh less than 2 pounds. Digital Light Processing is the product of the great minds at Texas Instruments. DLP™ uses a single Digital Mirror Device (DMD) chip that has thousands of tiny mirrors, each representing a single pixel. These mirrors tilt back and forth and deflect light as indicated by the source to create the image. One limitation of DLP™ technology thus far is brightness. Currently most of the brightest single-chip DLP™ projectors on the market are just 3,000 lumens compared to the 6,000+ lumens of comparably priced LCD's and three-chip DLP™ projectors. Brighter single chip DLP™ projectors are available, but are significantly more expensive. However, because of their deep, rich blacks and high contrast ratios, LP™ projectors have been a popular choice among home theater enthusiasts.

The three-chip DLP™ has the best looking images of all the players. The three-chip system is much like the single-chip DLP™ only better. The image quality of the three-chip DLP™ is unsurpassed. Unfortunately it is also the most expensive. Today's three-chip™ DLP projectors cost anywhere from $15,000-$30,000 or higher. Unlike CRTs and single-chip DLP™ projectors, three-chip DLP™ can have very high lumen output levels.

	LCOS/Liquid Crystal on Silicon is a "micro-projection" or "micro-display" technology typically applied in projection televisions. It is a reflective technology similar to DLP projectors; however, it uses liquid crystals instead of individual mirrors. This is contrary to LCD projectors which use a transmissive approach. In LCOS, liquid crystals are applied directly to the surface of a silicon chip coated with an aluminized layer, with some type of passivation layer, which is highly reflective. LCOS technology can produce much higher resolution imagers using highly advanced silicon technology than liquid crystal display and plasma display technologies, which makes it less expensive to implement in such devices as televisions.
Video Input Formats	
	A projector may support several different video input formats, each with different resolutions, colors, and compression.
	NTSC,1 NTSC 4.43 - U.S. standard National Television System Committee - 480 lines of data, displayed at 30fps - NTSC image are drawn 60 times a second
	PAL,2 PAL-M, PAL-N - European and international standard Phase Alternating Line - 576 lines, displayed at 25fps - PAL images are drawn 50 times a second
	SECAM3 - French and international standard
	SDTV (480i)
	EDTV (480p)
	HDTV4 (1080i/P, 720P, 480i/P) - New standard being adopted internationally
Aspect Ratio	
	The width-to-height ratio of a film or television image. A 4:3 display produces an image that is more square, and a 16:9 ratio produces an image that is more panoramic in shape.
	The 4:3 aspect ratio is typically associated with standard and enhanced resolution TV's, Computer Displays and most data projectors.
	The 16:9 aspect ratio is a movie standard and High Definition standard found in some CRT TVs but mostly in Rear Projection and Stand alone LCD and Plasma Televisions. Wide Screen notebooks and LCD display's for computers are typically 16:10. Some home theater and data projectors are starting to offer native 16:9 or digital scaling which is not as desirable as the native aspect ratio.
Contrast Ratio	
	Contrast is the ratio between the white and black parts in an image. The larger the contrast ratio of a display device, the greater is the difference between the brightest whites and the darkest blacks a video display or projector can show. A contrast ratio of say 300:1 would imply that the black level is 300 times darker than the white.
	Most home theater projectors are rated at between 500 and 3000 to 1 contrast ratio, while some of the latest plasma displays have a quoted contrast ratio of 10,000:1.
	Black can only be as black as the projection screen surface is in the ambient light present in the room. Hence, if the room is not pitch dark, the screen surface will reflect some light - thus turning black into dark gray, and therefore reducing image contrast ratio. Contrast Ratio Guide
Lumens	

	A measurement unit of total illumination.
	A rating of 1000 to 1500 ANSI lumens or lower is suitable for smaller rooms with controlled lighting or low ambient light. Between 1500 to 3000 ANSI is suitable for medium sized rooms with some ambient light or dimmed light. Over 3000 ANSI is appropriate for very large screens in a large room with no lighting control (for example, a conference room).
	Lumen Guide
Display Modes	
	Are often a combination of display resolution (specified as the width and height in pixels), color depth (measured in bits), and refresh rate (expressed in hertz). Associated with the screen resolution and refresh rate is a display adapter.
	VGA Video Graphics Array, introduced in 1987 by IBM. VGA is actually a set of different resolutions, but is most commonly used today to refer to 640 × 480 pixel displays with 16 colors (4 bits per pixel) and a 4:3 aspect ratio. Other display modes are also defined as VGA, such as 320 × 200 at 256 colors (8 bits per pixel) and a text mode with 720 × 400 pixels. VGA displays and adapters are generally capable of Mode X graphics, an undocumented mode to allow increased non-standard resolutions. Display resolution (pixels) 640×480 640×350 320×200 720×400 Aspect ratio 4:3 64:35 16:10 9:5
	SVGA Super VGA, a video display standard created by VESA for IBM PC compatible personal computers. Introduced in 1989. Display resolution (pixels) 800×600 Aspect ratio 4:3
	XGA Extended Graphics Array is an IBM display standard introduced in 1990. XGA-2 added 1024 × 768 support for high color and higher refresh rates, improved performance, and support for 1360 × 1024 in 16 colors (4 bits per pixel). Display resolution (pixels) 1024×768 640×480 Aspect ratio 4:3
	SXGA Super XGA, a widely used de facto 32 bit Truecolor standard, with an unusual aspect ratio of 5:4 instead of the more common 4:3 which means, if scaled, images appear wider on SXGA displays than most other resolutions. The resolution probably should have been 1280 × 960 which is a popular standard resolution for Unix

workstations.
* Some manufacturers, noting that the de facto industry standard was VGA (Video Graphics Array), termed this the Extended Video Graphics Array or XVGA.

Display resolution (pixels)
1280×1024
Aspect ratio
5:4

UXGA Ultra XGA is a de facto Truecolor standard and has the highest resolution of any normal aspect ratio (4:3) display in production.

Display resolution (pixels)
1600×1200

Aspect ratio
4:3

WUXGA Widescreen Ultra Extended Graphics Array is a version of the UXGA format. This display aspect ratio is becoming popular in high end 15" and 17" widescreen notebook computers.

Display resolution (pixels)
1920×1200

Aspect ratio
16:10

WQXGA Widescreen Quad Extended Graphics Array is a version of the XGA format. This display aspect ratio is becoming popular in some recent desktop monitors.

Display resolution (pixels)
2560×1600

Aspect ratio
16:10

WXGA Widescreen Extended Graphics Array is a version of the XGA format. This display aspect ratio is becoming popular in some recent notebook computers.

Display resolution (pixels)
1280×720 or 1280x800

Aspect ratio
16:9 or 16:10

WSXGA, or WXGA+ Widescreen Extended Graphics Array PLUS is a version of the WXGA format. This display aspect ratio is becoming popular in some recent notebook computers.

Display resolution (pixels)
1440×900

Aspect ratio
16:10

802.11b/g wireless video connection should be able to present HDTV 1080i and even 720p however all issues wireless connectivity such as interference should be considered

	when purchasing a projector with this option. This option will be primarily found on business class data projectors that HDTV is not usually a concern to the average business user.
Resolution	
	Refers to the sharpness and clarity of an image. The term is most often used to describe monitors, printers, and bit-mapped graphic images. When referring to monitors or projectors the terms screen or display resolution are most often used.
	SDTV 480i - The native resolution of an analog or standard definition TV is not known as it does not uses pixels to measure definition but 640X480 is an approximation. 480i is the correct designation for SDTV. The "i" in 480i stands for interlaced. Please see the next description for some clarification on this matter.
	EDTV 480p - The native resolution of Enhanced Television is 852X480 and 480p is correct designation for EDTV. The "p" in 480p stands for progressive. With out going into the technical differences between progressive scan and interlaced displays think of progressive scan as the display producing every frame as a single photograph and interlaced as 2 photos begin displayed with every other line missing and have to be switched back and forth quickly enough so the human eye perceives them as on image, AKA: POV.
	HDTV 1080i, 720p, 1080p - The native resolution High Definition Television is 1024x768 and 1080i is the correct designation for HDTV and is the most common HDTV broadcast format. The 720p is an alternate designation for HDTV that is actually progressive and is measured as 1280X720,1280X768, or 1366X768 . The newer 1080p is not widely supported yet and is not a broadcast standard however the new Blue Ray DVD format uses this resolution that measures in at 1,920x1,080. The 1080p designation on projectors and displays may not be native as this resolution maybe accomplished via a line doubler rather than a native resolution.
Lens Throw	
	AKA projection distance - A common throw distance is one foot of screen for every two feet of space between projector and screen. That is a general rule for projectors with a standard lens.
	Short throw lens projectors are able to create larger images with less distance between projector and screen. This is helpful in small class rooms and conference rooms.
	Long throw lens projectors help create smaller, more viewable images from greater distances. A long throw lens is advantageous in large venues, particularly in fixed installations. Churches often require long throw lenses for worship spaces, because the projector is often mounted far away from the screen, behind the congregation. Without a long throw lens, the image would be too large.
	Projection Calculator Pro
Network Connectivity	
	networkable projectors have RJ-45/Ethernet connections so that the projector can be accessed through a LAN or WAN. Some newer projectors are shipping with built in wireless routers as well. This gives IT departments the ability to manage projectors the same way other peripherals are managed. That means remote access and control to perform routine, sometimes time consuming and costly, tasks like troubleshooting, monitoring performance, and shutting down projectors throughout a large facility. Centralized monitoring enables projector operators/managers to save time by simultaneously viewing the status of all network projectors over their LAN including but not limited to input sources, power on/off and lamp life conditions. Built-in remote access also gives users virtual control of the projectors from remote locations over a network with the ability to troubleshoot and monitor them and even using e-mail

	notification.
	10/100
	10/1000
	802.11b
	802.11g
	802.11b/g
Other Features to Consider	
	Keystone Correction - Digital (cheap) or Optical (expensive)
	Lens Shift: The Lens Shift feature of a projector allows the optical lens to be physically shifted up and down (vertical) and/or left and right (horizontal). Some lens shift mechanisms are motorized with vertical lens shift being the most popular. Lens shift will can avoid or minimize the need for keystone correction. It is also used to geometrically align images when stacking projectors.
	Some cables - some projectors that offer all of the inputs in the world will limit there in the box cables usually to the least common denominator of the bunch. So if the projector has an HDMI and an s-video connector do not be surprised to find only one or the other. If the projector has audio support for FireWire, SPIDF and or optical do not be surprised not to find them in the box. Digital audio connects are expensive compared to RCA connects.
	Mouse and Keyboard - Wired (PS/USB) or Wireless (Infra, RF, Blue Tooth)
	Remote Control with or with out built in laser pointer (Infra RF)
	OSD - On Screen Display
	Multiple Video/computer inputs
	Monitor Pass through - see what's on computer monitor and projector screen.
	Mouse Emulation - This is handled either with a remote control or presentation pointing device. Note: A wireless Key Board and mouse can be beat.
	Built in speaker(s) - most data/business projectors will come with one built in speaker. If you are going to use a fixed projector in a conference room or auditorium a more robust audio system will need to be considered.
	Carrying case - most data/business projectors will come with a soft carry bag. If the projector to be purchased is going to be uses by a "Road Warrior" then a hard case purchase should be considered.
	Security Lock Slot - most data/business projectors will come with such a security slot but not with a cable lock.
	Passcode Security - Portable and fixed data/business projectors will allow for simple password projection with out having to bind to a domain.
Other Concerns	
	Temperature - How hot a projector ran use to be of large concern in the early days of projectors as the temp alone could cut a meeting short in small conference room. Today's concerns with temperature are more about bulb life and the overall health of the projector. Modern data and home theater projectors will not shut down a fan on projector even after a bulb has gown dark to slowly cool down a projector. Many

	projectors also have the ability to extend a bulbs life by limiting the lumens produced by the bulb. This is usually done via its OSD or through built in network monitoring tools.
	Sound - ensure that the decibels of an operating projector do not exceed the ability of viewers to hear a presenter or video. It must also be said that room size will also play a larger part in this.
	Bulb Life - Be realistic when choosing a projector and its usage. Be aware of the MFG's specs on bulb life and what replacement bulbs will cost. In some of the mobile and portable projectors the bulb can be as much as two thirds the purchase price. The new pocket projectors will be using LEDs so this discussion is not important.
	Physical Security - Is it possible to lock the projector with a cable lock
	Network Security - Can the device bind to the AD Domain or can it only be access using a built in pass code?
	Remote control - Infra Red vs. RF/Radio Frequency.

List of Appendices:

Related Documents:

References:
Outfitting Classrooms

High Definition: The Big Picture

Projector Central

Projector People

Projector Reviews

About - Home Theater

cNet - Projector Reviews

Audio Video Revolution

Best Buy's guide to Projectors

Big Screen Forums

Audio Video Science Forum

Wireless Local Area Networks (WLAN)

Purpose and Scope: Wireless networks must be carefully planned in order to provide a secure and reliable service to the end user. Although, this document is not intended to be a comprehensive guide to the implementation of wireless technology, it should be treated as a baseline for securing wireless networks.

Reason for Implementing: The Office of Education Technology (OET) is responsible for ensuring that the Kentucky Education Technology Systems (KETS) statewide network is secure and reliable. Over the past several years Wireless Local Area Network (WLAN) communication has become an increasingly popular means of connecting mobile devices such as laptops, PDAs and Smart Phones to the Internet and the Local Area Network. The number of planned and previously implemented Wireless LANs has increased to the point that standards and practices need to be articulated for this network service.

1) WLAN Acceptable Use

   A) Any user that requires access to wireless network services should be required to read and sign a copy of the district or school's Acceptable Use Policy prior to gaining access to the Wireless Network.

   B) Users should understand that wireless networks are inherently insecure. Therefore, the transmission of sensitive/confidential data should be encrypted at the application layer (i.e. SSL, SSH) or should not be allowed to be accessed via wireless network.

2) Installation and Security

   A) Access Control (MAC address filtering) / 802.1x Authentication

      1) Although, it is highly recommended that 802.1x authentication be implemented in conjunction with Media Access Control (MAC) address lists, it is not a requirement at this time. For small wireless network installations (e.g. <30 devices) Media Access Control (MAC) address lists may be used in place of 802.1x Authentication. For larger wireless network installations (e.g. >30 devices) 802.1x Authentication must be implemented. In either small or large deployments, if 802.1x Authentication is implemented, Media Access Control (MAC) address lists are not required.

   B) Configuration Passwords

      1) All Wireless Access Point (WAP) management interface passwords must be changed from the default. Passwords must be difficult to guess and at a minimum be alphanumeric 8 or more digits in length. See the SANS Institute's Password Policy for more information on creating secure passwords.

      2) All Wireless Access Point (WAP) management interface passwords should be changed periodically to reduce security threats.

   C) Connectivity

      1) Ethernet hubs transmit data to every device on the network segment, including wireless devices. An intruder would not only be able to see the data transmitted via the wireless network, but all devices connected to the segment including hard wired LAN devices. Therefore, all Wireless Access Points (WAP) must be connected directly to an Ethernet switch.

D) Dynamic Host Configuration Protocol (DHCP)

    1) Some Wireless Access Points (WAP) can be configured to give out Dynamic Host Configuration Protocol (DHCP) addresses directly. All Wireless Access Points must not be configured to assign DHCP addresses. Instead, they should be configured as a pass-thru or bridge device and allow Active Directory to assign and manage all DHCP address assignments.

E) Network Address Translation (NAT)

    1) Network Address Translation (NAT) allows several wireless devices to share a single IP address on the Local Area Network. This feature must be disabled on all Wireless Access Points because any accountability for those wireless devices would be lost.

F) Encryption

    1) All Wireless Access Points (WAP) must be configured with the highest possible encryption available. 128-bit Wi-Fi Protected Access (WPA) is preferred. However, some legacy devices do not support WPA, therefore it is not required. In such cases 128-bit Wired Equivalent Privacy (WEP) must be used.

    2) All Wireless Access Point (WAP) keys must be changed on a periodic basis.

G) Physical Security and Placement

    1) Wireless Access Points (WAP) should not be placed in locations that make them easy for someone to steal. All Wireless Access Points (WAP) should be either placed in a locked wiring closet, placed in a lockable enclosure, hidden from site above ceiling tiles or secured in such a way that removing them would damage them.

    2) A vendor site survey is not required prior to the implementation of a Wireless Local Area Network (WLAN), however it is recommended. As the placement of the Wireless Access Point (WAP) must be carefully planned and should take the following into consideration:

        (a) If Wireless Access Points (WAP) that are on the same RF channel are placed too close to one another, the overlap may result in interference in the overlapped area.

        (b) Wireless Access Points (WAP) should be strategically located to prevent the interception of wireless signals by unauthorized individuals. The range must be tested to ensure that signals are not being transmitted outside the intended coverage area.

        (c) Wireless Access Points (WAP) must be installed so they do not violate state or local fire codes.

        (d) The number of devices a Wireless Access Point (WAP) can support can differ depending on the type of use that is expected. The following should be used as an initial starting point for determining the number of Wireless Access Points (WAP) that are required to provide Wireless Local Area Network (WLAN) coverage.

        (e) Heavy Usage – (up to 20) devices all accessing the network concurrently to access web pages, low to medium quality streaming video, large file transfers, etc.

        (f) Medium Usage – (21 to 40) devices using the network, but not in a coordinated fashion. For example all working independently on projects, etc.

        (g) Light Usage – (41 to 60) devices using the network on a casual basis and concurrency of use is random and minimal. This would also include large numbers on concurrent users accessing low bandwidth applications such as email.

H) Security Review

1) Periodic security reviews should be performed to ensure that changes to the Wireless Local Area Network (WLAN) have not exposed the network to intruders.

2) The network should be periodically scanned to detect unauthorized wireless devices.

I) Security Switch

1) Wireless Security Switches are not required as long as all security measures outlined in this document are met. However, wireless security switches are highly encouraged in large deployments due to the many benefits that they provide including: Centralized Management for up to 120 Wireless Access Points, Acceptable User Policy Enforcement, Quality of Service (QoS) Policy Enforcement, Usage Tracking, Location Tracking, etc…

J) Service Set Identifier (SSID)

1) The Service Set Identifier (SSID) should not openly identify the Local Area Network (LAN) or its purpose and should be constructed as securely as a password.

2) The regular broadcasting of the Service Set Identifier (SSID) must be disabled on all Wireless Access Points (WAP).

K) Simple Network Management Protocol (SNMP)

1) Simple Network Management Protocol (SNMP) settings should be changed from the default and should have access control lists where possible.

L) Updates (Firmware & Software)

1) Software and Firmware updates from the wireless manufacture(s) should be applied to Wireless Access Points (WAP) and wireless devices as soon as possible after release to correct any security vulnerabilities.

M) Virtual Private Network (VPN) Integration

1) Virtual Private Network (VPN) Integration is currently not required in Wireless Local Area Network (WLAN) deployments. However, VPN solution can be utilized to provide an extra layer of protection between the WLAN and the LAN.

N) Wireless Local Area Network (WLAN) Technology

1) All Wireless Access Points (WAP) must support 802.11 a/b/g standards and n once standard has been adopted.

Approved Vendors:
- Enterasys Networks
- Nortel Network

Acronyms/Abbreviations:
- DHCP - Dynamic Host Configuration Protocol
- MAC Address - Media Access Control Address
- NAT – Network Address Translation
- SNMP – Simple Network Management Protocol
- SSID – Service Set Identifier
- VPN – Virtual Private Network
- WAP – Wireless LAN Access Point

- WEP – Wired Equivalency Privacy
- WLAN – Wireless Local Area Network
- WPA – Wi-Fi Protected Access

Minimum KDE PC Workstation Standards as of 10/10/08

Minimum Standards	Stationary Workstation (Desktop/Tower) Units		
	Level 1 – Stationary ****RESERVED**** **NOT RECOMMENDED**	Level 2 – Stationary (STANDARD DESKTOP)	Level 3 – Stationary (ENHANCED DESKTOP) **Recommended for CAD or high-end graphics users**
Processor	2.8 GHZ Pentium – Dual Core	2.8 GHz Pentium – Dual Core Hyperthreading capable	2.4Ghz Core 2 Duo
Installed Memory Minimum	1GB 1x1GB	2GB 2x1GB	2GB 2x1GB
Memory Expansion Capability	2 GB SDRAM total	4 GB	4 GB SDRAM without replacing existing memory
Cache Minimum	1 MB Integrated L2 Cache	2MB Integrated L2 Cache	2 MB Integrated L2 Cache
Slots	1 PCI/PCI X/ PCI Express slot	2 PCI/PCI X/PCI Express slots	2 PCI/PCI X/PCI Express slots
Hard Drive Minimum	40 GB SATA 7200 RPM	80GB SATA 7200 RPM	120GB SATA 7200 RPM
Audio	No current specification	Integrated AC97 Audio	Integrated AC97 Audio
Video	128MB video memory or integrated/shared video meeting that level	128MB video memory or integrated/shared video meeting that level	512MB video memory or integrated/shared video meeting that level
Graphics Support	Graphics support 1280 x 1024 @ 75Hz	Graphics support 1280 x 1024 @ 75Hz	Graphics support 1280 x 1024 @ 75Hz
Ports - VGA Graphics	1 VGA Graphics	1 VGA/Digital Graphics	1 VGA/Digital Graphics
Ports - Keyboard PS/2 or USB	1 Keyboard PS/2 or USB	1 Keyboard PS/2 or USB	1 Keyboard PS/2 or USB
Ports - Mouse	1 Mouse PS/2 or USB	1 Mouse PS/2 or USB	1 Mouse PS/2 or USB
Ports - Universal Serial Bus (USB)	4 Universal Serial Bus (USB) 2.0	6 Universal Serial Bus (USB) 2.0	6 Universal Serial Bus (USB) 2.0
CD/Rom	Minimum 24X internal, CD-ROM w/Sound	Minimum CD RW/DVD ROM	Minimum CD RW/DVD RW
Input Devices - Mouse	101 Key Keyboard	101 Key Keyboard	101 Key Keyboard
Input Devices - Keyboard	2 Button Optical Mouse	2 Button Optical Mouse	2 Button Optical Mouse
Operating System	Windows XP Professional installed	Windows Vista Business	Windows Vista Business
Drivers	Shall have all standard and optional drivers installed on each unit	Shall have all standard and optional drivers installed on each unit	Shall have all standard and optional drivers installed on each unit

Driver - Network Interface	Include, at a minimum, network interface, CD/ROM, hard disk, modem, video, etc.	Include, at a minimum, network interface, CD/ROM, hard disk, modem, video, etc.	Include, at a minimum, network interface, CD/ROM, hard disk, modem, video, etc.
Network	Configured with one (1) Ethernet network adapter (10/100/1000)	Configured with one (1) Ethernet network adapter (10/100/1000)	Configured with one (1) Ethernet network adapter (10/100/1000)
Network - visual LEDs	Must demonstrate visual LEDs to show link integrity and activity	Must demonstrate visual LEDs to show link integrity and activity	Must demonstrate visual LEDs to show link integrity and activity
Network - automatic sensing reconfig	Must have automatic sensing and reconfiguration for the speed of the hub or switch port	Must have automatic sensing and reconfiguration for the speed of the hub or switch port	Must have automatic sensing and reconfiguration for the speed of the hub or switch port
Bay		Must have expandability for one (1) additional internal bay	Must have expandability for one (1) additional internal bay
Energy Star Compliant	Yes	Yes	Yes

Minimum KDE PC Workstation Standards as of 10/10/08

Minimum Standards	Portable Workstation Units				
	Level 1 – Portable ****RESERVED**** **NOT RECOMMENDED**	**Level 2 – Portable** (STANDARD LAPTOP)	**Level 3 – Portable** (ENHANCED LAPTOP) **Recommended for CAD or high-end graphics users**	**Tablet**	**Mini Device**
Processor	2.8 GHZ Pentium – Dual Core	Installed – 2.0 GHz, Core 2 DUO with 915 chipset	Installed – 2.4 GHz, Core 2 DUO with 915 chipset	1.60 GHz, Core 2 DUO w/915 chipset	1.20 GHz
Installed Memory Minimum	1GB 1x1GB	2GB 2x1GB	2GB 2x1GB	1 GB. 1DIMM (1x1GB)	1 GB. 1DIMM (1x1GB)
Memory Expansion Capability	2 GB RAM total	4 GB RAM total	4 GB RAM total	4 GB RAM total	
Cache Minimum	1 MB, L2 Cache	2MB, L2 Cache	2 MB, L2 Cache		
Slots	Minimum of 1 Type II, PCMCIA slots	Minimum of 1 Type II, PCMCIA slots	Minimum of 1 Type II, PCMCIA slots		
Hard Drive	Minimum 30GB storage capacity	Minimum 80GB storage capacity	Minimum 120GB storage capacity	80GB 4200 RPM	80GB HD or 16 GB SSD
Audio	Integrated AC97 Audio	Integrated AC97 Audio	Integrated AC97 Audio	Integrated AC97 Audio	
Video	128MB video memory or integrated/shared video meeting that level	128MB video memory or integrated/shared video meeting that level	256MB video memory or integrated/shared video meeting that level		
Graphics Support				Intel 950 Graphics Media Accelerator	
Ports - VGA Graphics	1 VGA Video Port	1 VGA Video Port	1 VGA Video Port		1 VGA Video Port
Ports - Universal Serial Bus (USB)	2 USB Ports (at least 1 must be free after external keyboard and mouse installed)	3 USB Ports (at least 2 must be free after external keyboard and mouse installed)	3 USB Ports (at least 2 must be free after external keyboard and mouse installed)	3 USB Ports (2 must powered)	2 USB Ports
CD/ROM	Minimum 24X internal, CD-ROM w/Sound	Minimum CD RW/DVD	Minimum DVD/RW	24X CDRW/DVD-ROM Combo	
Modem	Minimum of 56k integrated	Minimum of 56k integrated	Minimum of 56k integrated		
Display	Minimum of 12", HPA, Color, 800 x 600	Minimum of 14", HPA, Color, 1024 x 768	Minimum of 15", XGA, Active Matrix, Color, 1024 x 768	14.1" Wide Screen WXGA LCD	8.9" Wide Screen 800 x 600

Battery	Must include one Lithium Ion or Lithium Polymer Battery	Must include one Lithium Ion or Lithium Polymer Battery	Must include one Lithium Ion or Lithium Polymer Battery		Must include one Lithium Ion or Lithium Polymer Battery
	3-hour usage without plug in	3-hour usage without plug in	4-hour usage without plug in		4.5-hour usage without plug in
Operating System	Windows Vista Business	Windows Vista Business	Windows Vista Business	Windows Vista Business	Windows XP Pro installed
Drivers	Shall have all standard and optional drivers installed on each unit	Shall have all standard and optional drivers installed on each unit	Shall have all standard and optional drivers installed on each unit		
Driver - Network Interface	Include, at a minimum, network interface, CD/ROM, hard disk, modem, video, etc.	Include, at a minimum, network interface, CD/ROM, hard disk, modem, video, etc.	Include, at a minimum, network interface, CD/ROM, hard disk, modem, video, etc.		Include, at a minimum, network interface, hard disk, video, etc.
Network	Configured with an Internal Ethernet (10/100) adapter	Configured with an Internal Ethernet (10/100) adapter	Configured with an Internal Ethernet (10/100) adapter		Configured with an Internal Ethernet (10/100) adapter
Network - automatic sensing reconfig	Configured with an Internal wireless (802.11b)	Configured with an Internal wireless (802.11b/g)	Configured with an Internal wireless (802.11b/g)	1390 WLAN (802.11g, 54Mbps)	1390 WLAN (802.11g)
Energy Star Compliant	Yes	Yes	Yes		

Minimum KDE Apple Workstation Standards as of 02/28/07

Minimum	Stationary Workstation (Desktop/Tower) Units		
Standards	Level 1	Level 2	Level 3
Processor		1.83 GHz Intel Core 2 Duo	
Installed Memory		1GB, 1x1GB	
Memory Slots			
Memory Expansion Capability			
Cache			
Slots			
Hard Drive		60GB SATA	
Diskette			
Sound Card		Integrated AC97 Audio	
Video		Intel 950 Graphics Media Accelerator	
Graphics Support			
Ports - VGA Graphics			
Ports - Keyboard PS/2 or USB			
Ports - Mouse			
Ports - Universal Serial Bus (USB)			
CD/Rom		24X CDRW/DVD-ROM Combo	
CD/Rom			
CD/Rom			
Input Devices			
Input Devices			
Operating System		MAC OS 10.4.6	
Drivers			
Driver - Network Interface			
Driver - CD/ROM			
Driver - Hard disk			
Driver - Modem			
Driver - Video			
Network			
Network - visual LEDs			
Network - automatic sensing re-config			
Network			
Network - Internal Wireless			
Network - Plug & Play Device Compatible with XP Professional			
Bay			
Battery			
Battery Usage			
Battery Recharge			
Modem			
Modem - credit card dial-up networking XP Pro			

Modem - 55#s/call			
Support Plug & Play Device XP Pro			
Shiva Dial-up Routers			
Display			
Laptop carrying case			
Energy Star Compliant		Y	
Warranty-Minimum		3 Year On-Site	

Minimum KDE Apple Workstation Standards as of 02/28/07

Minimum	Portable Workstation (Laptop/Tablets) Units			
Standards	Level 1	Level 2	Level 3	Tablet
Processor		1.83 GHz Core 2 Duo		
Installed Memory		1GB, 1 DIMM		
Memory Slots				
Memory Expasion Capability				
Cache				
Slots				
Hard Drive		40GB SATA		
Diskette				
Sound Card				
Video		Intel 950 Graphics Media Accelerator		
Graphics Support				
Ports - VGA Graphics				
Ports - Keyboard PS/2 or USB				
Ports - Mouse				
Ports - Universal Serial Bus (USB)				
CD/Rom		CDRW/DVD-ROM Combo		
CD/Rom				
CD/Rom				
Input Devices				
Input Devices				
Operating System		MAC OS 10.4.6		
Drivers				
Driver - Network Interface				
Driver - CD/ROM				
Driver - Hard disk				
Driver - Modem				
Driver - Video				
Network				
Network - visual LEDs				
Network - automatic sensing reconfig				
Network				
Network - Internal Wireless		Airport Extreme Card		
Network - Plug & Play Device Compatible with XP Professional				
Bay				
Battery				
Battery Usage				
Battery Recharge				
Modem				
Modem - credit card dial-up networking XP Pro				
Modem - 55#s/call				

Support Plug & Play Device XP Pro				
Shiva Dial-up Routers				
Display		13.3" Wide Screen		
Laptop carrying case				
Energy Star Compliant				
Warranty-Minimum		NBD-On-Site Response, 3 Year Depot with Accidental Damage Warranty		

PC Server Technical Specifications Standard

Server Specifications						
Level 1 – Tower	**Level 2 – Tower**	**Level 3 – Tower**	**Level 4 – 1U Rack Mount Ready**	**Level 5 – 2U Rack Mount Ready**	**Level 6 - Blade Chassis**	**Level 6 - Blade Server**
Processor						
Minimum 2.4 GHz Intel Xeon or the equivalent	Minimum 2.4GHz Intel Xeon with EM64T Support or the equivalent	Minimum 3.16 GHz 64 Bit Xeon MP or the equivalent	Minimum 2.4 GHz Pentium 4 with EM64T Support or the equivalent	Minimum 2.4 GHz Xeon with EM64T Support or the equivalent		
Motherboard speed – 400 Mhz	Motherboard speed – 400 MHz	Motherboard speed – 400 Mhz	Motherboard speed – 400 MHz	Motherboard speed – 400 MHz		
	Dual processor capable	Quad processor capable		Dual processor capable		
Memory						
Minimum 1 GB RAM	Minimum 1 GB RAM	Minimum 2 GB RAM	Minimum 1 GB RAM	Minimum 1 GB RAM		
Expansion capability 4GB RAM	Expansion capability 4GB RAM	Expansion capability 8 GB RAM	Expansion capability 4 GB RAM	Expansion capability 8 GB RAM		
Cache						
Minimum of 512KB L2 Cache	Minimum of 512KB L2 Cache	Minimum of 1024KB L2 Cache full speed	Minimum of 512KB L2 Cache	Minimum of 512KB L2 Cache		
Hard Drive						
Minimum 36GB	Minimum 36GB	Minimum of four drives with 36 GB	Minimum of 1 - 36GB	Minimum of 1 - 36GB		
			Minimum 2 hot swappable hard drive bays	Minimum 5 hot swappable hard drive bays		
Video						
Minimum 4 MB built-in	Minimum 4 MB built-in	Minimum 4 MB built-in	Minimum 4 MB built-in	Minimum 4 MB built-in		
Minimum resolution 1024 x 768	Minimum resolution 1024 x 768	Minimum resolution 1024 x 768	Minimum resolution 1024 x 768	Minimum resolution 1024 x 768		
Hard Drive Controller						
Single channel array controller	2 Channels, minimum of 6 devices per channel	2 Channels, minimum of 6 devices per channel	single channel array controller	2 Channels		
	1 external SCSI interface	1 external SCSI interface				
Power Supplies						
Redundant not required	Redundant required	Redundant required	Redundant not required	Redundant capable		

Hot pluggable not required	Hot pluggable required	Hot pluggable required	Hot pluggable not required	Hot pluggable required		
Fans						
Minimum 2	Minimum 3	Minimum 3	Minimum 2	Minimum 4		
Hot pluggable not required	Hot pluggable not required	Hot pluggable required	Hot pluggable not required	Hot pluggable required		
Physical Internal Storage						
Minimum 3 drive bays	Minimum 6 drive bays	Minimum 10 drive bays	Minimum 2 drive bays	Minimum 4 drive bays		
Server Footprint						
			Must be 1U server	Must be 2U server		
Internal DVD-ROM						
8X DVD	8X DVD	8X DVD	8X DVD	8X DVD		
Keyboard						
USB Interface	USB Interface	USB Interface	USB Interface	USB Interface		
Mouse						
USB Interface	USB Interface	USB Interface	USB Interface	USB Interface		
System Bus						
Minimum 4 PCI/PCI X/PCI Express slots	Minimum 5 PCI/PCI X/PCI Express slots	Minimum 6 PCI/PCI X/PCI Express slots	Minimum 2 PCI/PCI X/PCI Express slots (before External SCSI interface or Remote Management Access card)	Minimum 2 PCI/PCI X/PCI Express slots (before External SCSI interface or Remote Management Access card)		
Rackmountable						
Capable	Capable	Capable	Must come rack-mount ready with all rack mount rails, etc, which are specific to server manufacturer.	Must come rack-mount ready with all rack mount rails, etc, which are specific to server manufacturer.		
External Ports						
Minimum 3 USB port	Minimum 3 USB port	Minimum 3 USB port	Minimum 2 USB port	Minimum 2 USB port		
Minimum 1 VGA port	Minimum 1 VGA port	Minimum 1 VGA port	Minimum 1 VGA ports	Minimum 1 VGA ports		
Network						
Configured with one (1) Ethernet network adapter (10/100/1000)	Configured with one (1) Ethernet network adapter (10/100/1000)	Configured with one (1) Ethernet network adapter (10/100/1000)	Configured with one (1) Ethernet network adapter (10/100/1000)	Configured with one (1) Ethernet network adapter (10/100/1000)		
Must demonstrate visual LEDs to show link integrity and activity	Must demonstrate visual LEDs to show link integrity and activity	Must demonstrate visual LEDs to show link integrity and activity	Must demonstrate visual LEDs to show link integrity and activity	Must demonstrate visual LEDs to show link integrity and activity		

Must have automatic sensing and reconfiguration for the speed of the hub or switch port	Must have automatic sensing and reconfiguration for the speed of the hub or switch port	Must have automatic sensing and reconfiguration for the speed of the hub or switch port	Must have automatic sensing and reconfiguration for the speed of the hub or switch port	Must have automatic sensing and reconfiguration for the speed of the hub or switch port		
Must support Category 5e UTP	Must support Category 5e UTP	Must support Category 5e UTP	Must support Category 5e UTP	Must support Category 5e UTP		
Remote Management Access						
			Add-on PCI or Built-in	Add-on PCI or Built-in		

Template used for sections to be completed:

Topic

Classification: New Structure, Renovation, or Addition

Item:

- Hardware
- Enter Data
- Last line

Administrative Items to be considered:

- Software
- Enter Data
- Last line

Types of Projection Displays

- Enter Data
- Last line

Related Documents: